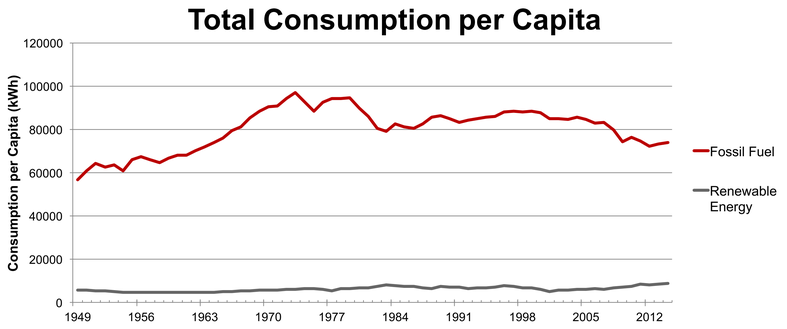
FISHER COLLEGE OF BUSINESS – HONORS THESIS IN FINANCE

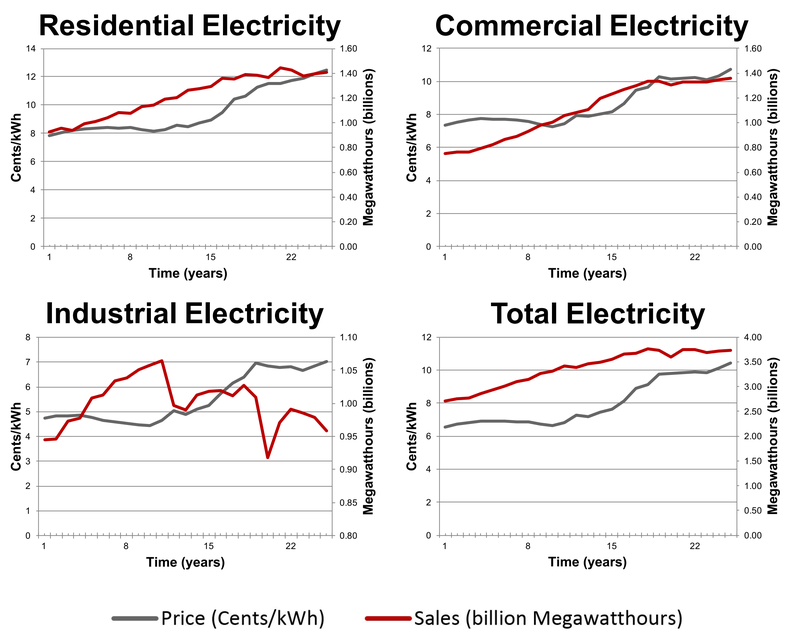
# Vulnerability of the National Electric Grid to Renewable Power Consumption

Kenneth Elsbernd, Advisors: Neil Drobny, Ralph Greco, Adam Smith, Patricia West

## TRENDS

- Overall fossil fuel consumption and renewable energy consumption increasing on the aggregate
- Increasing renewable energy consumption and decreasing fossil fuel consumption once normalized for United States population




## FINDINGS

- Increases in renewable energy consumption per capita and increasing electricity prices will likely bring a decrease in fossil fuel consumption per capita
- Changes in the profitability of utilities will not be drastic in the near future, but could become severe in the distant future
- End users are price inelastic, thus unlikely to exit the national electric grid quickly
- Greatly increased prices could eventually drive even the price inelastic consumers to other sources of electricity

## METHODOLOGY

**Predictive Regression Model:**

*log(Fossil Fuel Consumption per Capita) = 8.910 - 0.116 * log(Renewable Energy Consumption per Capita) - 0.394 * log(Total Electricity Price) + 0.002 * (Year)*

$R^2$=0.859

**Price Sensitivity Analysis:**

*log(Residential Electricity Sales) = -28.459 - 0.550 * log(Residential Electricity Price) + 0.025 * (Year)*

*log(Commercial Electricity Sales) = -36.659 - 0.389 * log(Commercial Electricity Price) + 0.029 * (Year)*

*log(Industrial Electricity Sales) = 24.477 - 0.189 * log(Industrial Electricity Price) - 0.002 * (Year)*

*log(Total Electricity Sales) = -10.358 – 0.353 * log(Total Electricity Price) + 0.016 * (Year)*

## ASSUMPTIONS

- Utilities sector profit margins are consistent over time
- Aggregated pricing is a good predictor of the industry outlook
- All U.S. geographic regions have comparable energy utilization
- Mutual exclusivity of utility sector markets
- Fossil fuel consumption per capita is an adequate proxy for utilities sector profits
- Fossil fuel and renewable energy are one-to-one substitutes
- Chosen regression model variables are adequate predictors of the dependent variable
- Regulation does not have an effect on the actions of the end user and the utilities sector

## FURTHER RESEARCH

**Alterations of the Data**

- Less aggregated data across geographical regions (utilize state- or regional-level data)
- Electricity pricing solely from renewable sources
- Ratio of fossil fuel to renewable energy consumption by utility companies
- Regulatory environment impact analysis

**Logical Model**

- Cause and effect analysis, instead of statistical forecasting

**Expansion of Time Horizon** (more observations)

## ACKNOWLEDGEMENTS

My deepest gratitude goes to my committee: Dr. Neil Drobny, Professor Ralph Greco, PhD Candidate Adam Smith, and Dr. Patricia West for all of the aid and guidance that they have provided.